Review of: "Does energy always have mass?"

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Unfortunately there are some problematic misunderstandings in this article that invalidates most of the conclusions. It should first be noted that gravitational redshift is a well established fact both theoretically (within general realtivity) and empirically, so the claim that this effect is not real cannot be supported.

In rebutting the argument from Misner, Thorne, and Wheeler, the author claims that the mass of the particle when being lifted in the gravitational field should be m+mgh, however this is not true. mgh is a potetial energy associated with the combined system of Earth and the mass m and means that the mass of the combined system of Earth and m is smaller than the sum of the mass of Earth and the mass m individually. This effect is most vividly seen in atomic nuclei but can also be seen in the hydrogen atom which has a mass slightly smaller than the mass of the proton plus the mass of the electron. The difference is the binding energy of the hydrogen atom. Since the potential energy is associated with the combined system it will not affect a local measurement of the mass of m.

A version of this seems to also be the problem in the later argument that outgoing photons are not redshifted. This argument is that photons losing energy to the gravitational field would violate energy conservation. However, phtons like all particles do lose energy when going up a gravitational well, this energy is not locally recoverable at the top because it goes to the combined system of Earth plus photon, it can only be recovered by sending the photon back down (note, the exact same thing happens if we use a massive particle instead of a photon). Therefore there is no problem with energy conservation and gravitational redshift. As mentioned, gravitational redshift is also experimentally verified.

The final thought experiment also falls when gravitational redshift is taken into account. So yes the electric potential energy does add to the mass of the capacitor and anything else would violated enrgy conservation.

These leads to the conclusions, there is a statement that E=mc^2 leads to a sort of double counting the energy, however ths is a misunderstanding. It is not that the energy in the capacitor is stored both as potential energy and mass; saying it is stored as potential energy and saying it is stored as mass are two ways of saying the same thing. When energy is taken out of the capacitor, its energy decreases and its mass decreases such the E=mc^2 holds at all times. The energy taken out is equal to the reduction in potential energy and therefore the mass decreases by that energy /c^2 for E=mc^2 to hold.

One final remark, I do agree that not all energy is equivalent to mass, but that concerns kinetic energy, E=mc^2 is only valid for things at rest.